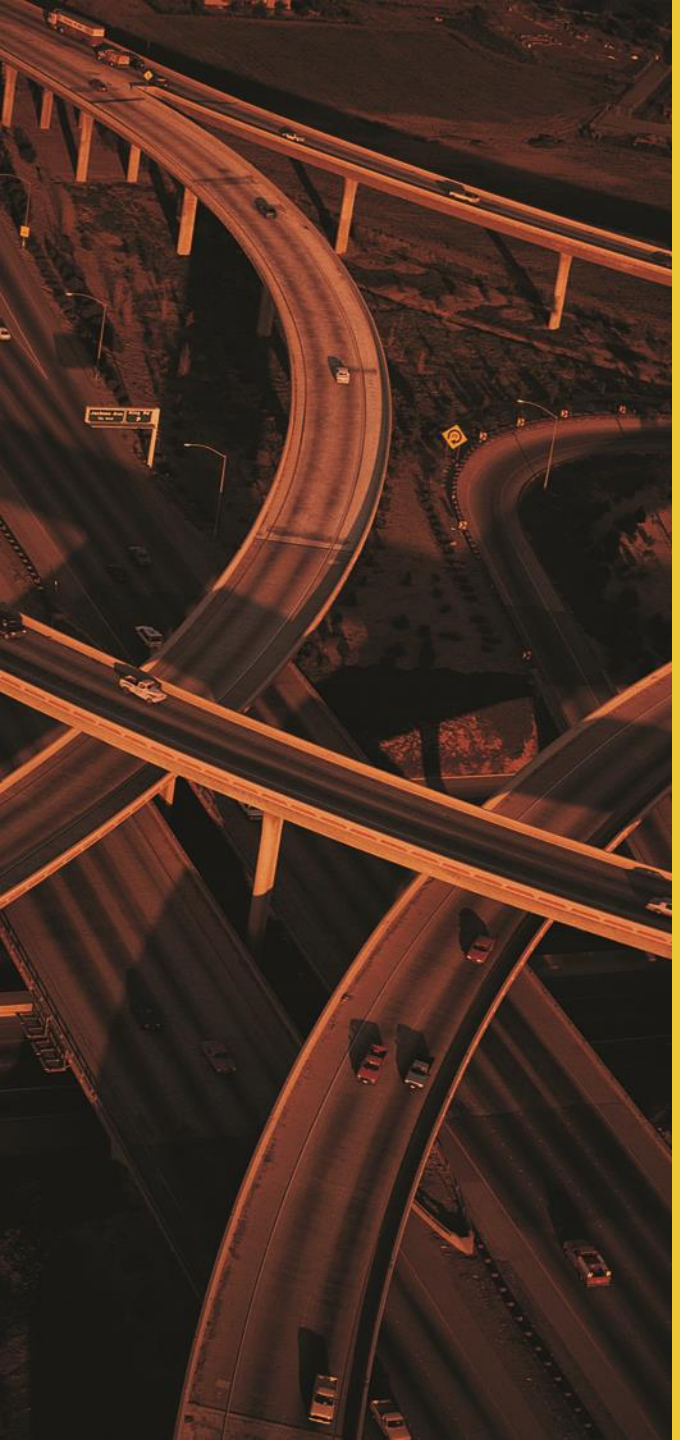


RUTGERS

Center for Advanced Infrastructure and Transportation

A U.S. Department of Transportation University Transportation Center

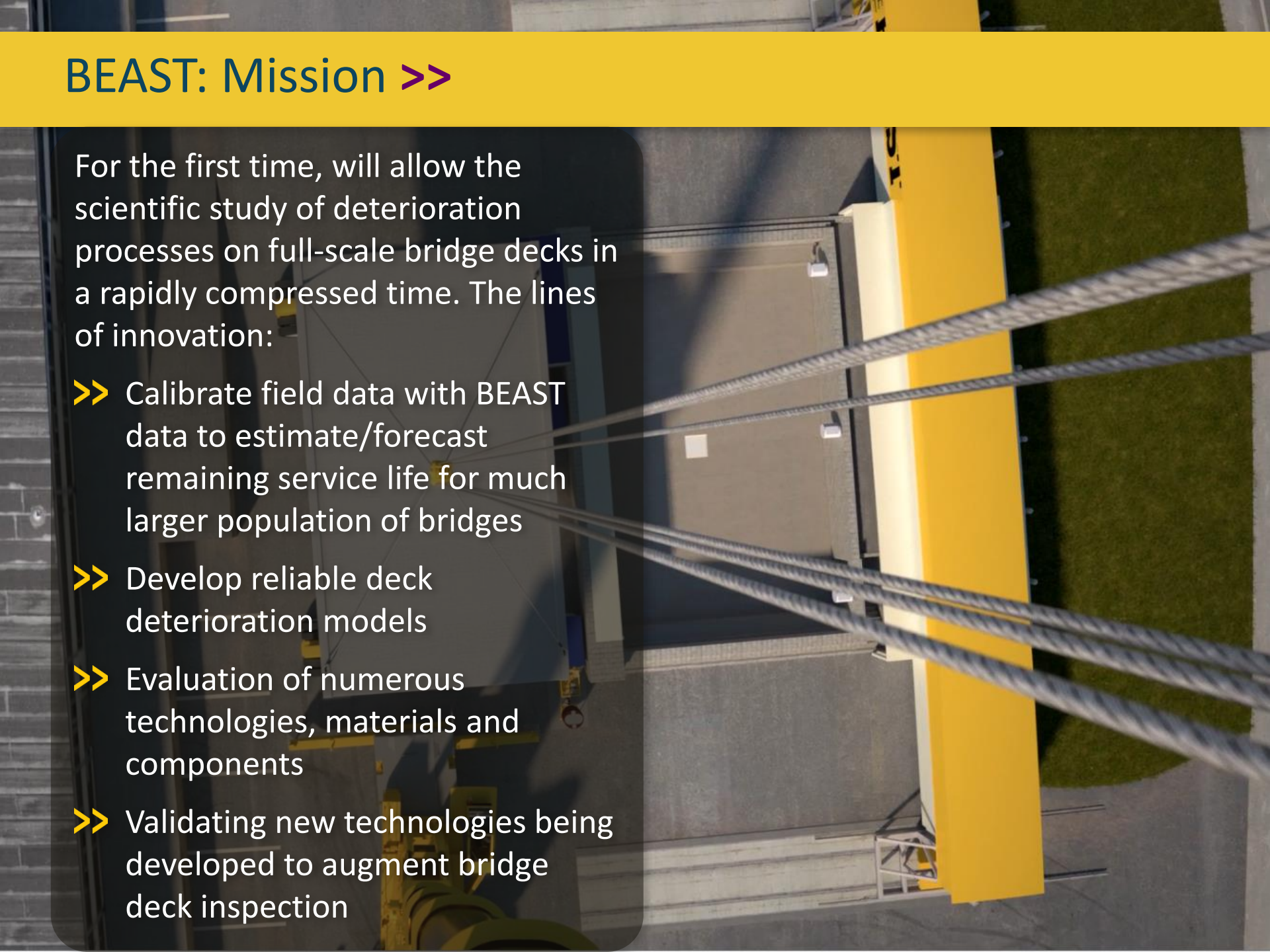
NJDOT Showcase: Bridge Evaluation and Accelerated Structural Testing Lab

October 28, 2015

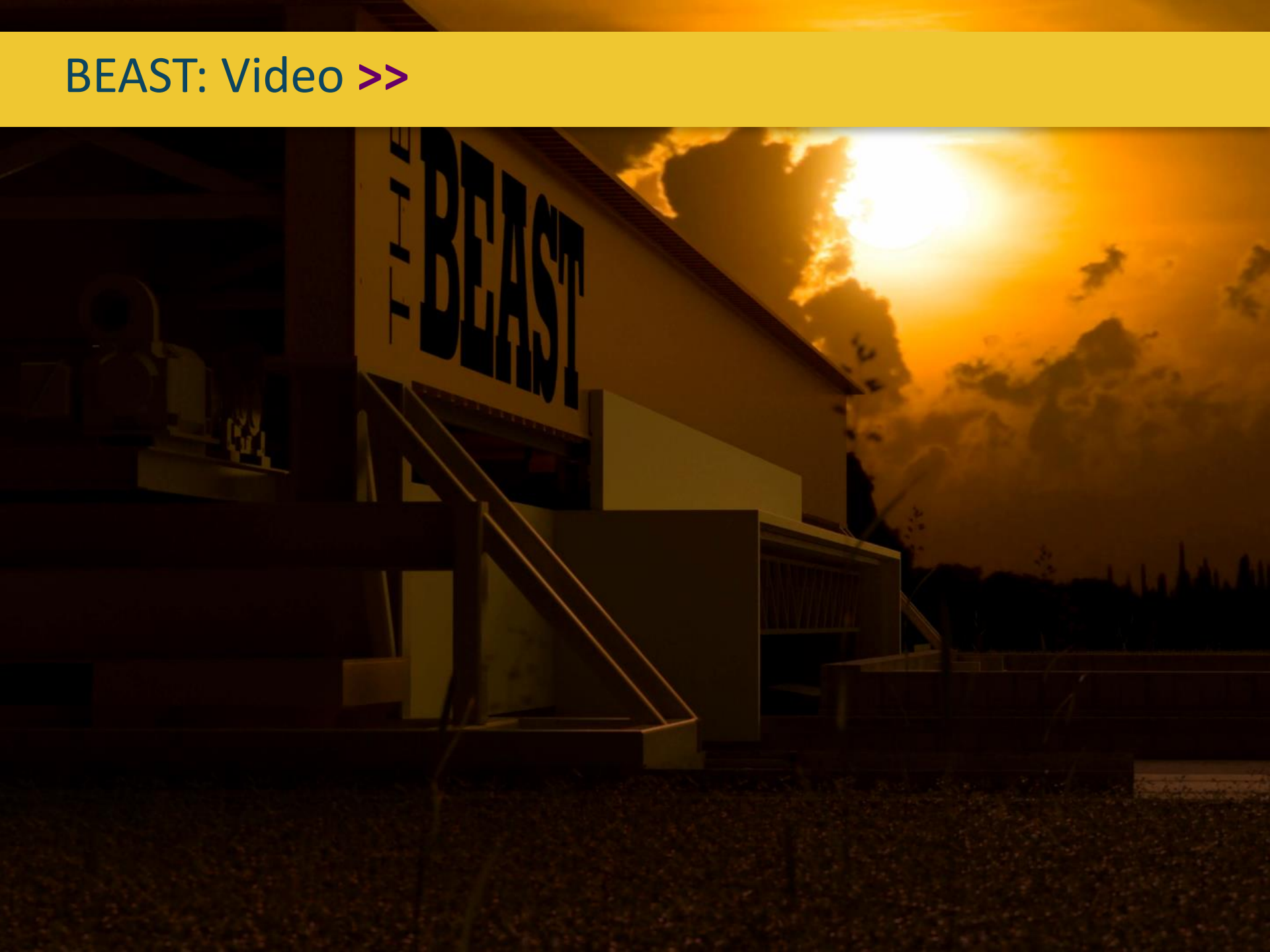
BEAST: Mission >>

For the first time, will allow the scientific study of deterioration processes on full-scale bridge decks in a rapidly compressed time. The lines of innovation:

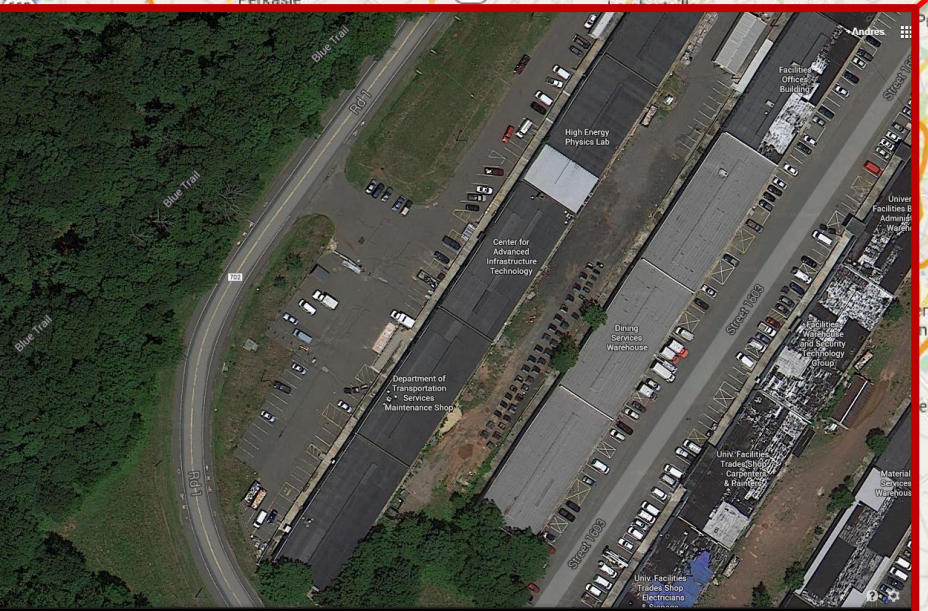
- Calibrate field data with BEAST data to estimate/forecast remaining service life for much larger population of bridges
- Develop reliable deck deterioration models
- Evaluation of numerous technologies, materials and components
- Validating new technologies being developed to augment bridge deck inspection



BEAST: Video >>



Site Location – Livingston Campus >>



Access to major routes:

- Route I-95 – 6.5 miles
- Route I-287 – 5.5 miles
- NJ Route 18 - 2 miles
- NJ Route 1 - 5 miles

BEAST: Site Features >>

BEAST: Technical Specifications>>

Specification	Bridge Deck Tester
Bridge Specimen Size	50-ft span by up to 28-ft wide
Specimen Superstructure Depth	Up to 60 inches above floor
Overall Length (ft)	Approximately 125 feet
Overall Weight (lb)	120,000 lb
Max Normal Load (lb) Normal	60,000
Min Normal Load (lb) Normal	10,000
Trafficking Speed (mph)	0 to 20
Primary Drive System	Electric winch
Drive System Power (hp)	400 HP
Axle Size	Two Full 30,000 lb capacity each
Portability	Lateral movement provided between loading cycles
Bi-directional Loading	Yes
Electrical Power	3 Phase 480 Volt

Testing Capabilities: Bridge Systems, Components & Materials >>

Concrete	Any concrete bridge deck mix design, corrosion inhibitors, supplemental cementing materials, and additives
Decking Systems	Open, filled, partially-filled or unfilled grid decks such as exodermic bridge deck systems; orthotropic or other metal deck systems; prefabricated deck systems; precast slabs; and others
Rebar	Steel, epoxy coated, galvanized, stainless steel, steel clad, glass and carbon fiber polymer, etc.
Prestressing & Post-tensioning Strands	Bar, wire, strands, couplers, anchorages, ducts, and other components
Coatings & Sealants	Latex-modified concrete, joint sealants, epoxy waterproofing seal coating, etc.
Superstructure Frames	Structural steel, reinforced concrete, precast concrete, prestressed concrete, and timber
Joints	Preformed joint filler, elastomeric joint assemblies, strip seal expansion dams, modular bridge joint systems, longitudinal joints, shear locks, and others
Bearings	Bearing pads, reinforced elastomeric bearing assemblies, high-load multi-rotational bearing assemblies, and others
Deck Drainage	Scuppers, inlets, downspouts, grates, and other drainage elements
Safety Devices	Striping paint, pavement reflectors, auditory safety devices (e.g., Bott's dots, rumble strips, etc.), ITS devices and sensors, traffic cams, signage materials, and more

Environmental Loading Protocol>>

Summary of Protocol

- Mean Stage - Two days at 65F
- Min Stage - Five days at 0F
- Mean Stage - Two Days at 65F
- Max Stage - Five Days at 104F
- 1% Brine solution applied during Min Stages

Features

- Estimated to produce 15 to 20 years of environmentally induced deterioration in 6 months
- Accommodates periodic assessments during median temperature cycles

Live Loading Protocol>>

Loading Magnitude

- Full 60 kip – results in roughly twice the force effects and local stresses of a typical, legal truck
- Half 30 kip – most realistic

Loading Frequency

- Maximum is approximately 20,000 cycles per day
- Over 6 months this results in 3.65 million cycles
- Corresponds to 15 years of truck traffic on a bridge with ADTT of 650

Loading Configuration

- Stationary – worst case, unrealistic
- Roving – Options 1 and 2 changed during Mean Temperature Cycles

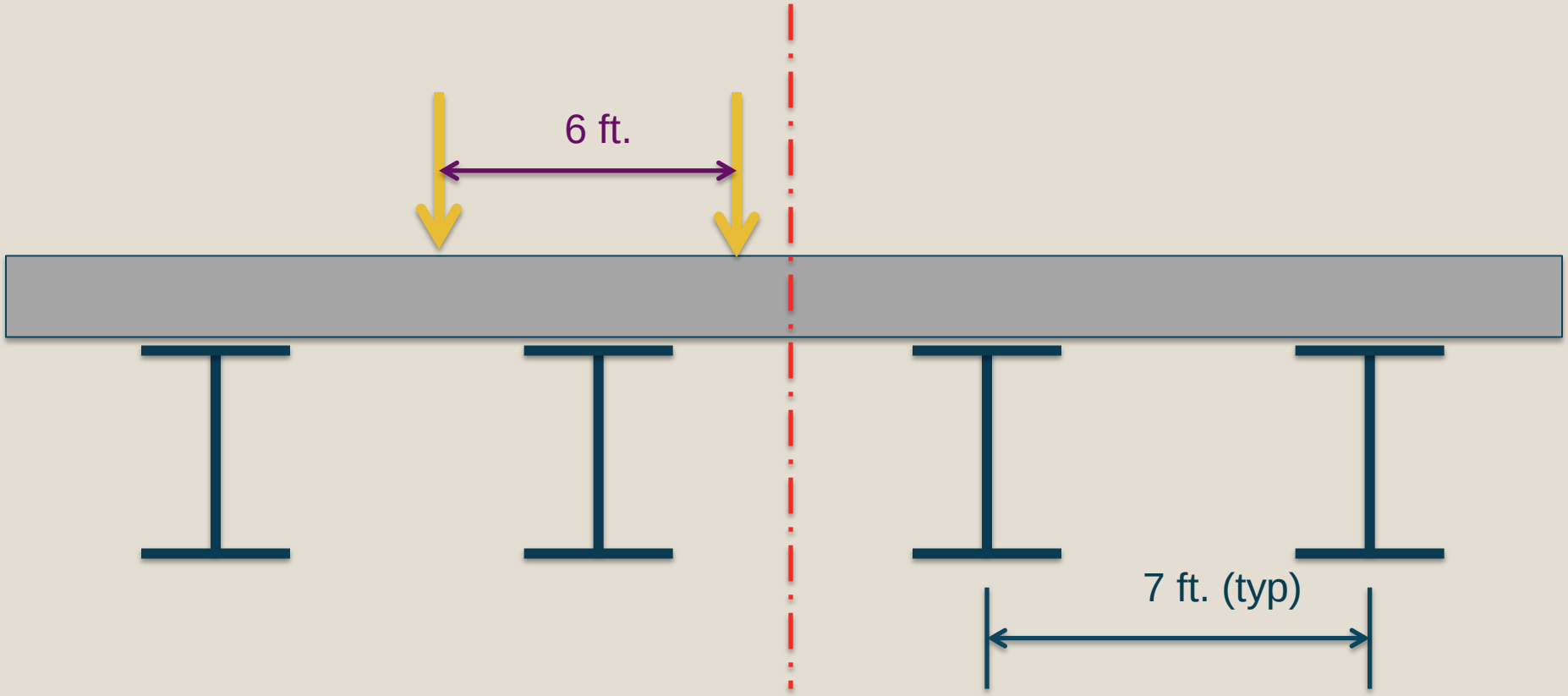
Questions? >>

>> cait.rutgers.edu

Thank you!

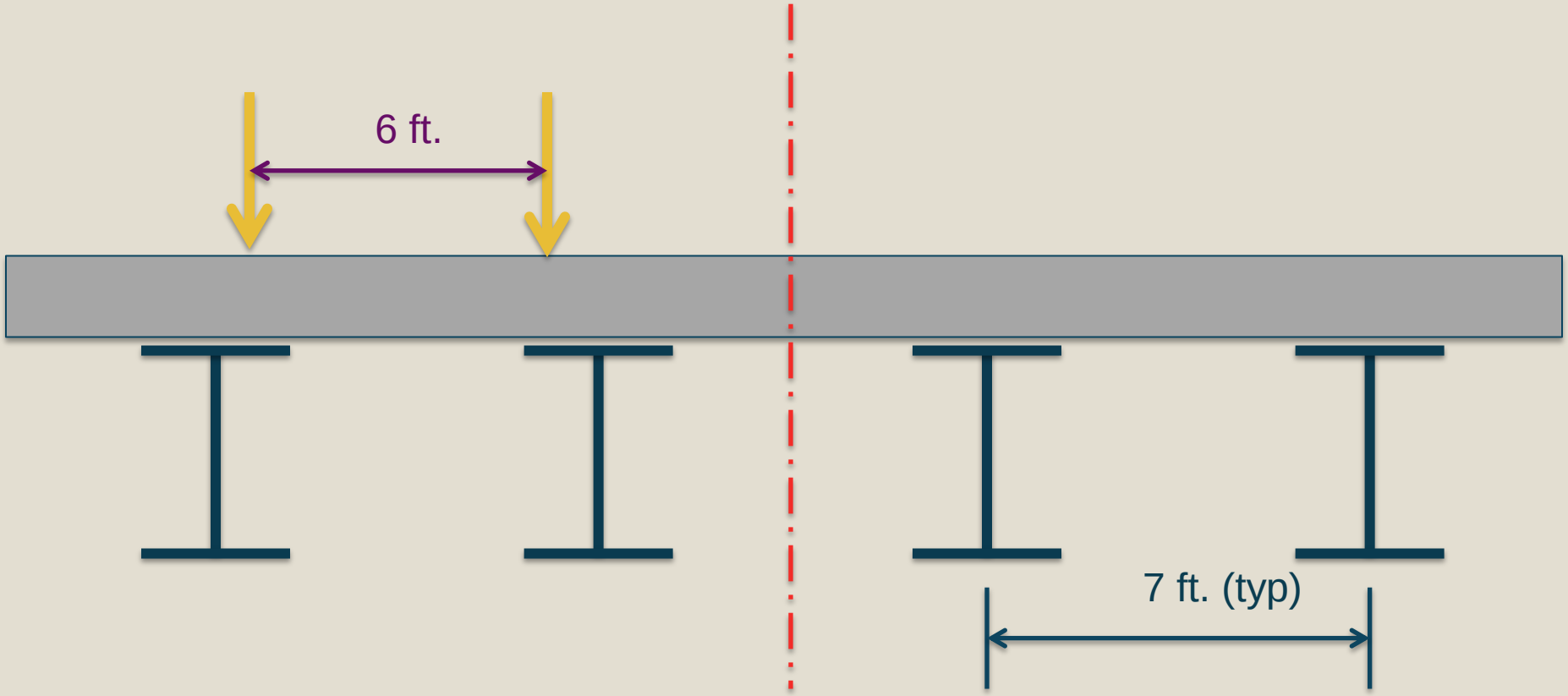
Live Loading Protocol (Option 1) >>

Maximum, Realistic Deck Force Effects



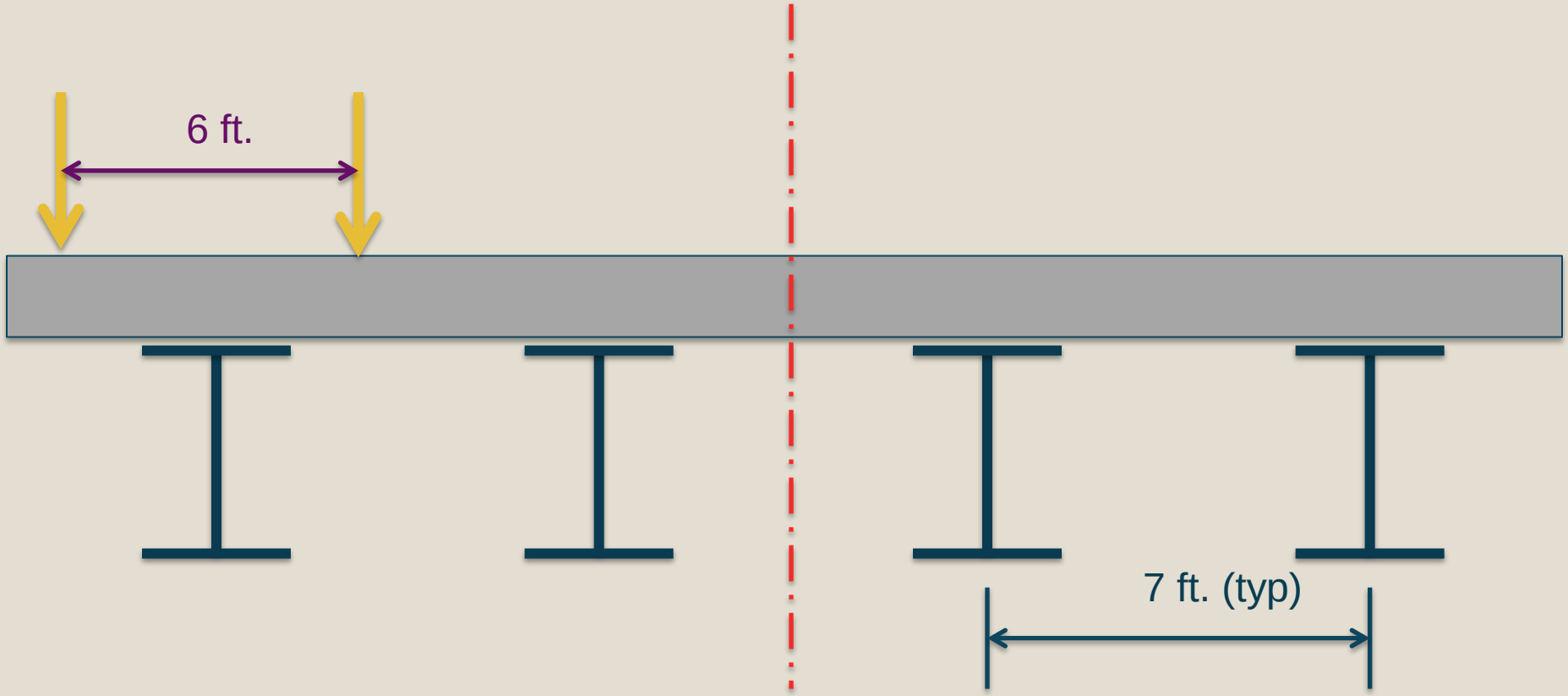
Live Loading Protocol (Option 2) >>

Minimum Deck Force Effects



Live Loading Protocol (Option 3) >>

Maximum, Unrealistic Deck Force Effects



Potential Fixed Instrumentation >>

(low spatial resolution, high temporal resolution)

Global

- A series of RGB cameras, including live load mounted
- A series of IR cameras

Deck

- Groups of embedded VW strain gages and thermistors
- Curing, dead load, temperature, live load stresses
- Redistribution of stresses due to shake-down, deterioration
- Uniform grid of chloride and corrosion sensors

Girders, Diaphragms

- Groups of 3 to 4 longitudinal VW strain gages, thermistors, and displacement sensors: ¼- Mid-, ¾ - Span
- Dead load, curing, temperature and live load stresses
- Location and migration of N.A. (dead load, temperature, live load)
- Initial and changes in transverse load distribution (dead load, temperature, live load)
- Fiber Optic WIM to capture shear forces

Periodic Data Collection >>

(high spatial resolution, low temporal resolution)

Carried out on a base interval during Mean Temperature Cycles and based on sensor responses or thresholds

- **Comprehensive, multi-modal NDE scanning (RABIT)**
- **Modal impact testing to estimate frequencies and mode shapes (THMPR)**
- **NBIS Bridge Inspection**
- **Inspection as per LTBP Protocols**

Potential Payload Projects>>

Long-term Performance of…

- Sensing and data acquisition
- Utilities and conduit
- Roadway condition sensors

More Fundamental Projects

- Development and validation of approaches to integrate NDE, SHM, and visual inspection
- Reliability of NDE, sensing, etc.
- Development and validation of mechanistic-based simulation modeling of deterioration
- Quantification of the reliability of model-experimental correlation approaches